Examination of environmental drivers and seasonal dynamics associated with the development and persistence of Harmful Algae Blooms in western Lake Erie

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Overview

- Environmental factors contributing to bloom initiation, persistence, and toxicity are not well understood.
- Advancements in our HABs detection and prediction for western Lake Erie (WLE) have occurred through integration of weekly monitoring, continuous/real-time data, remote sensing and innovative modeling programs.
- Seasonal dynamics in nutrient inputs, including both tributary loadings and internal inputs associated with wave driven resuspension are being examined to quantify their influence on the timing, distribution and intensity of HABS biomass and toxicity.
- Continuous monitoring results indicate that internal re-supply of phosphorus through resuspension may greatly exceed that of tributary inputs and has the potential to impact bloom duration, as well as dampen the ecosystem's response to nutrient load management strategies.

Approaches

Weekly Field Monitoring

- Single surface sample (approx. 0.7 m) collected by Niskin
- Bloom density (CHL, PC, TSS, VSS)
- Nutrients (TP, TDP, SRP, NO_3, NH_4)
- Microcystin (particulate and dissolved)
- Composition (DNA, microscopy, flowcam)
- CTD profile
- Hand-held hyperspectral radiometry
- Used to calibrate and validate remote sensed estimates
- Distributed to regional water intake managers weekly

Continuous Mooring Monitoring

- 15 minute resolution of chlorophyll, phycocyanin, turbidity, CDOM, temperature, and conductivity
- Hourly dissolved phosphorus concentrations
- Real-time on GLERL's HABS website

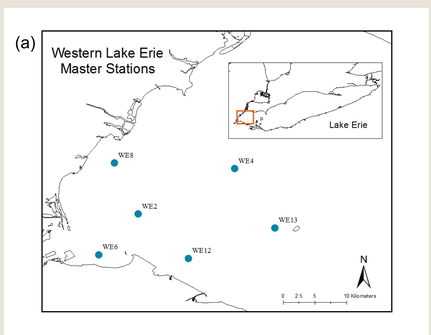

Figure 1. (a) Weekly field monitoring stations are located in the western basin of Lake Erie, highlighted in red. Continuous mooring data is collected at WE2, WE4, and WE8. WE13 will be added to the continuous mooring data sites for 2015. (b) An example of the instrumentation located at moorings.

Results- Weekly Field Monitoring

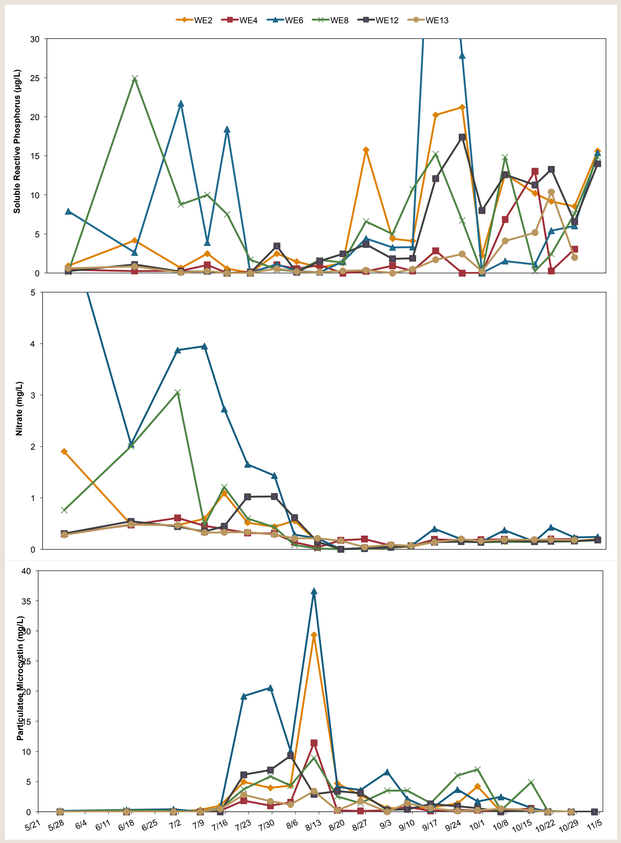

Figure 2. Water chemistry and toxins in 2014. Though SRP may be required to initiate the bloom, nitrate may be required to sustain bloom toxicity.

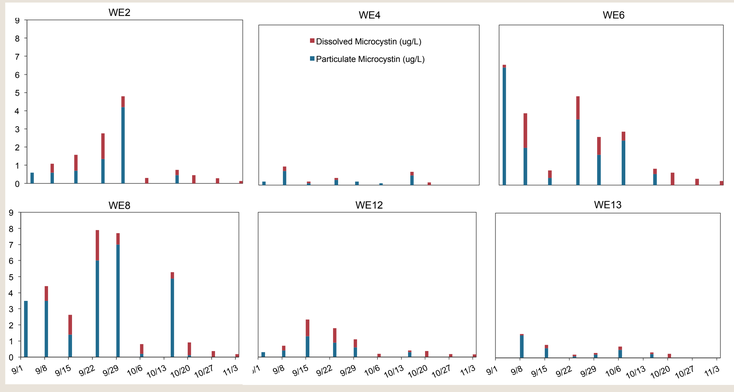

Figure 3. Particulate and dissolved microcystin in 2014. Dissolved microcystin frequently accounts for more than 50% of total microcystin.

Results- Continuous Mooring Monitoring

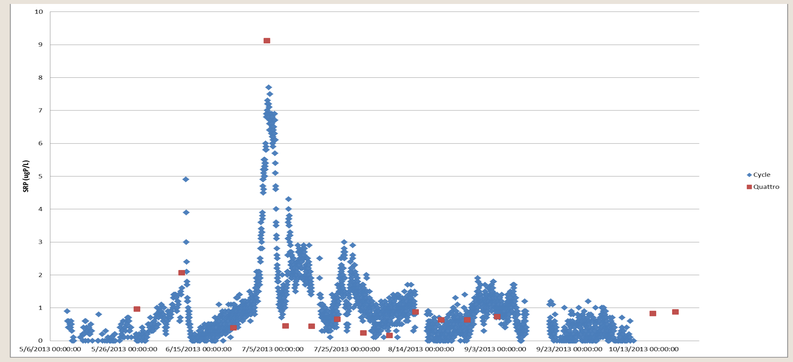

Figure 4. Time series of SRP at WE4 measured at hourly intervals in 2013. Increased temporal resolution is able to capture SRP dynamics that may not be visible when sampled once per week.

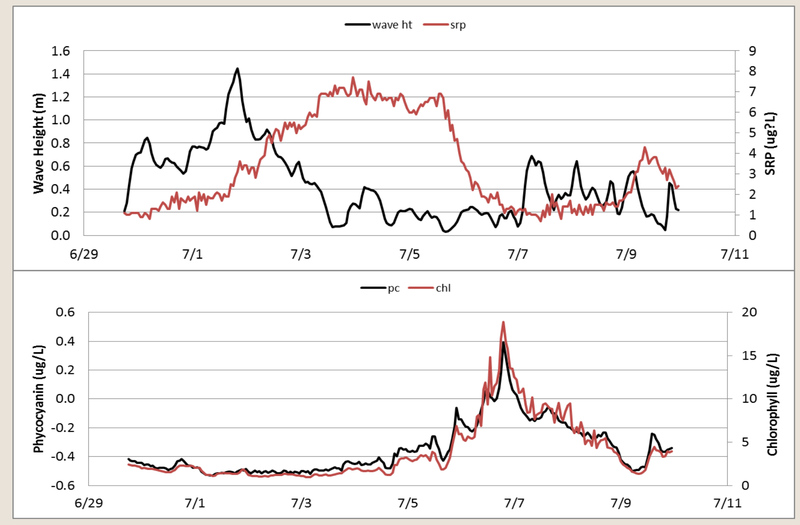

Figure 5. Resuspension event time series at WE4 in 2013. Increased wave height was followed by an increase of SRP. As *microcystis* used this SRP, chlorophyll and phycocyanin spiked while SRP sharply decreased.

Conclusions

Lake Erie is a highly dynamic system. Water quality and cyanobacterial harmful algal bloom (CHAB) conditions can vary significantly over timescales of just days and spatially over scales of just a few kilometers. The current monitoring approaches are aimed at improving our understanding of factors that influence the extent, distribution, and toxicity of CHABs in Lake Erie. This improved understanding will lead to improved ability to model and forecast CHAB conditions for regional intake managers and recreational users. Moreover, improved understanding of the relationship between water quality conditions and CHAB dynamics will aid in the ultimate nutrient loading management strategies adopted by the region.